DUST CLEANER AND DUST CLEANING METHOD

The present invention relates to a dust cleaner and dust cleaning method for removing dust adhering to the surface of an object.

A conventional dust cleaner for removing dust adhering to the surface of an object is shown in figures 3 & 4. A compressible fluid is sent from a blower 2 and blown out from a punkah louver 4 through a high efficiency particulate air filter 3. One apparatus known in the prior art includes an object 13 passing on rollers 6 and dust adhering to the surface is blown off by this compressible fluid.

Another apparatus is also known which generates ionized air by corona discharge, removes static electricity of a charged article by blowing ionized air, then blows compressed air from an air nozzle on to the article from which the charge is also removed. Dust adhering to the surface of the article is also removed and the apparatus sucks and removes the removed dust by a duct.

In production plants of integrated circuits, a method has been used which comprises blowing off dust by high pressure air at each fabrication step using an air blower, then discharges the dust blown off by an exhaust dust and attempts to prevent the dust from adhering once again.

Such technology is disclosed, for example, in Japanese Patent Publication Nos. 267414/1988 and 130169/1988.

However, these conventional dust cleaners for removing dust adhering to the surface all suffer the disadvantage that static electricity charged on the lower surface of the object which rests on the support cannot be removed, and any floating dust is able, once again, to adhere to the object. Static electricity is generated by the action of blowing the object , which then vibrates and static results.

It is an object of the present invention to provide a dust cleaner and method of dust cleaning so as to remove any dust adhering to the entire surface of an object by emitting a clean compressible fluid from a nozzle disposed on the same side as an object support means,as well as ions from an electrostatic ion eliminator to remove static electricity charged on the object, and thereby to prevent re-adhesion of the floating dust.

According to the present invention, there is provided a dust cleaner for removing dust to the surface of an object, comprising fluid permeable support means having a first surface for supporting objects and a second surface on a side thereof opposite to said first surface, a nozzle adjacent said second surface, means for supplying compressed fluid to said nozzle, an electrostatic ion emitter provided inside said nozzle whereby a mixed supply of ions and compressed fluid can be passed through the support means to clean objects on said support means and remove static electricity.

Preferably the object or objects are placed on a blow washing tray or a blow washing basket with or without a net lid, and are put onto a belt conveyor of the support means. The support means may move until the objects pass out of the dust removing chamber.

A preferred embodiment of the present invention will now be described with reference to the accompanying drawings, of which:

Fig. 1 is an explanatory view of a dust cleaner of the preferred embodiment;

Fig. 2 is a side view of the dust cleaner of the preferred embodiment;

Fig. 3 is a side view of a conventional dust cleaner; and

Fig. 4 is an explanatory view showing the flow of a compressible fluid in the conventional dust cleaner.

In Fig. 1, objects such as cases 7 of a timepiece are placed in a blow washing tray 12 in such a manner that the glass of the case 7 faces up. The blow washing tray 12 is net-like at the bottom and is partitioned into a matrix to store a plurality of objects therein. After the objects 7 are set, a net lid 14 is placed on the blow washing tray 12. This lid 14 is net-like in order to improve the passage of air and gases. The lid 14 prevents objects from falling off the blow washing tray 12.

A belt 5 is driven and moved by a plurality of rollers 6. The blow washing tray 12 is placed on the belt 5.

The blow washing tray 12 is moved simultaneously with the operation of the belt 5 by a driving mechanism (not shown in the drawing).

When the moving blow washing tray 12 crosses the position of an operation sensor 10 using a photoelectric tube, a clean compressible fluid 32 is discharged from a clean compressible fluid nozzle 9.

The clean compressible fluid 32 is produced from a compressible fluid 31 by a filtration filter 22. The filtration filter 22 incorporates a filter for removing particulate dust, greater than 0.01 μm for example, and can withstand a compressible fluid pressure of up to about 10 kg/cm^2.

After the clean compressible fluid 32 passes through the filtration filter 22, its pressure is regulated by a clean compressible fluid pressure reducing valve 23. The

pressure can be changed within the range of about 1 to 10 kg/cm^2/. In the preferred embodiment, it is set to about 2 kg/cm^2.

The object 7 is an electrostatically charged article and electrostatic ions are emitted by the electrostatic ion eliminator 8 from an electrosatic ion emission needle 15. At this time, an electrostatic ion and clean compressible fluid mix 33 is discharged from the clean compressible fluid nozzle 9.

Sometimes a structure is employed wherein the object 7 is moved up and down inside the blow washing tray 12 by the electric ion clean compressible fluid 33. The size of each compartment inside the tray is designed to be somewhat greater than the object 7 and the height of the partition is set to be smaller than the greatest dimension of the object 7 lest the objects 7 turn upside down or mutually overlap. At this time, any dust adhering to the object 7 is blown off by the clean compressible fluid 32. When the object 7 is charged electrostatically, the dust is removed and static electricity is eliminated by the electrostatic ion clean compressible fluid mix 33.

When the moving tray 12 passes a stop sensor 11 comprising another photoelectric tube after the dust removing operation is completed, emission of clean compressible fluid 32 or the electrostatic ion clean compressible fluid mix 33 is stopped.

In Fig. 2, the compressible fluid is discharged from the blower 2, is cleaned by the high efficiency particulate air filter 3 and is discharged as clean air 24 from the punkah louver 4 into the dust removing chamber 1.

For cleaning the upper surface of the object 7, the clean compressible fluid 32 or the electrostatic ion clean compressible fluid mix 33 is discharged from the upper clean compressible fluid nozzle 21.

If an object 7 does not need to be placed into the blow washing tray 12, the dust is removed when it is placed in a blow washing basket 13 in which no partition is necessary.

An electrostatic ion emission needle 15 is disposed inside the punkah louver 4 in order to eliminate any charge inside the dust removing chamber 1 as a whole.

The compressible fluid in the present invention is an inert gas having high stability such as air, nitrogen gas, and argon.

To remove dust totally from the object, an operation switch for moving the object support means is turned on. At this time, a blower inside the dust removing chamber is operated simultaneously with the start of the movement of the object support means, and a clean fluid passing through a high efficiency particulate air filter is blown out from a punkah louver provided on both side surfaces and the upper part of the chamber and cleans the inside of the chamber.

When the objects move on the support means and the tray or basket pass by a photoelectric sensor inside the dust removing chamber, on the inlet side in the travelling direction, the compressible fluid passes through a filtration filter in a downward direction on the upper side as the object support means, and clean compressible fluid at a pressure of 1 - 10 kg/cm^2 is discharged from a plurality of clean compressible fluid nozzles. At the same time, electrostatic ions for removing the static electricity charged on the object are emitted from the same nozzles, and the dust blown off from the object is sucked to the lower part of the object support means, returns to the blower, is purified by the high efficiency particulate air filter and is emitted into the dust removing box from the punkah louver.

To remove dust from the underside the object is blown by the pressure of the clean compressible fluid from the nozzle disposed underneath the support means, and the adhering dust falls off from the object when vibration is applied. Here, electrostatic ions are also blown on to the object lest it is again charged electrostatically through the consequential vibrations and abrasions. The non-charged object then moves and when it passes by the stop sensor disposed at the outlet part in

the travelling direction, the clean compressible fluid and the electric static ion eliminator are stopped quickly.

The aforegoing description has been given by way of example only and it will be appreciated that modifications can be made without departing from the scope of the present invention. For example, objects such as a semiconductor material, a glass sheet, food package surface, plastic ceramic etc can be cleaned of dust. Where higher quality is required, the dust removing chamber i of the main body as a whole can be provided with a positive pressure sealed structure.

When the object to be cleaned comprises components associated with semiconductors, the objects can be set not only parallel to the belt surface but also at right angles or at a predetermined angle to the belt surface.

As described above, the dust cleaner for removing dust adhering to the surface of an object uses means for directly blowing clean compressible fluid at the object, electrostatic ion elimination means for eliminating static electricity charged on the object by the electrostatic ion clean compressible fluid mix, means for blowing from underneath the object and the operation sensor and stop sensor means using photoelectric tubes. Accordingly, not only dust adhering to the upper surface and side surfaces of the object but also dust adhering to the object on the support means side can be removed. When the object is electrostatically charged, static electricity can also be eliminated by the use of the electrostatic ion clean compressible fluid mix. Therefore, the dust removing performance can be improved and re-adhesion of dust hardly occurs.

CLAIMS

1. A dust cleaner for removing dust adhering to the surface of an object, comprising fluid permeable support means having a first surface for supporting objects and a second surface on a side thereof opposite to said first surface, a nozzle adjacent said second surface, means for supplying compressed fluid to said nozzle, an electrostatic ion emitter provided inside said nozzle whereby a mixed supply of ions and compressed fluid can be passed through the support means to clean objects on said support means and remove static electricity.

2. A dust cleaner as claimed in claim 1, wherein said first surface is vertically above said second surface and said nozzle and emitter are beneath the support means.

3. A cleaner as claimed in claim 1 or 2, further comprising a nozzle and emitter on the side of the first surface remote from the second surface.

4. A cleaner as claimed in claim 1, 2 or 3, wherein filtration filter means are incorporated in said means for supplying compressed fluid.

5. A dust cleaner as claimed in any one of claims 1 to 4, wherein the support means comprises a net-like tray.

6. A dust cleaner as claimed in claim 5 wherein the tray has a net-like lid.

7. A dust cleaner as claimed in any one of claims 1 to 6, further comprising object moving means for moving said support means and at least one object detection means for recognising the presence of an object.

8. A dust cleaner substantially as described with reference to either of the embodiments shown in Figures 1 and 2 of the accompanying drawings.

9. A dust cleaning method for removing dust adhering to the surface of an object comprising placing an object on fluid-permeable support means and blowing a mixed supply of ions and compressed fluid through the support means to clean the object thereon and remove static electricity.

10. A dust cleaning method as claimed in claim 9 and substantially as hereinbefore described.